Dec. 19, 1933. C. W. VOGT 1,940,473

APPARATUS FOR PROCESSING CONTROL

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FIG. 2

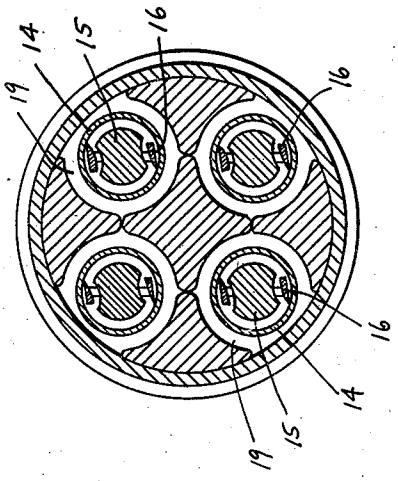
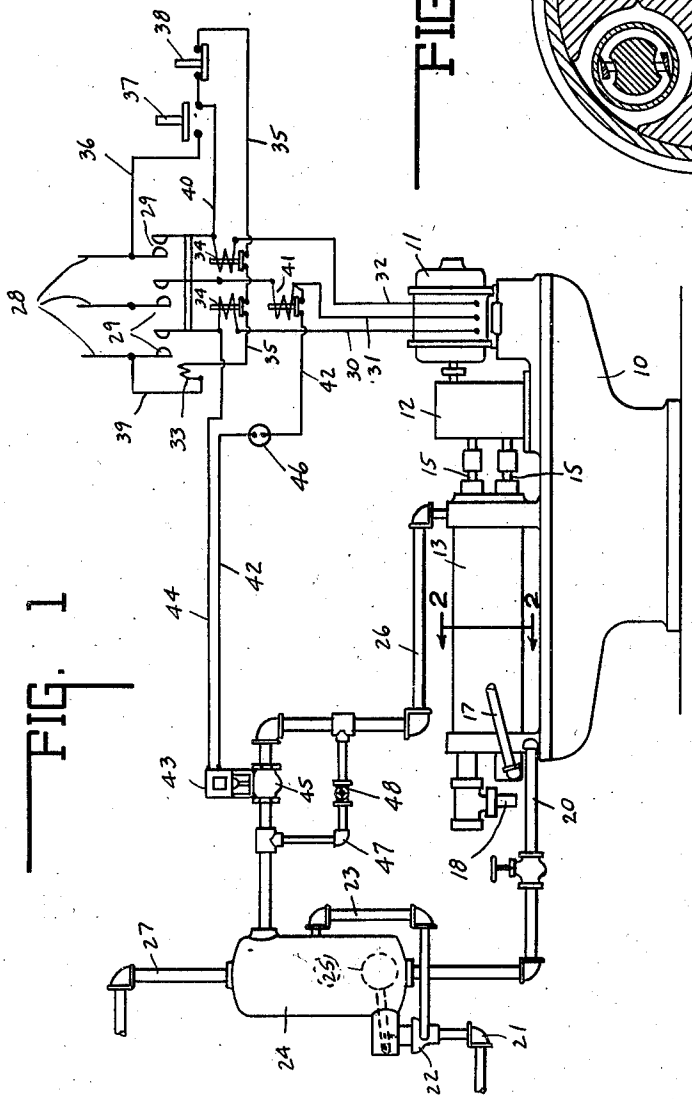


FIG. 1



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APPARATUS FOR PROCESSING CONTROL

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18 Claims. (Cl. 62—114)

This invention relates to a control for a processing apparatus in which the physical condition of a material is changed during the processing.

In many commercial processes the material in process is congealed or thinned by the use of a state-changing medium. Such a medium may take the form of a temperature-changing medium for heating or cooling the material.

The object of the present invention is to provide a method and apparatus for automatically controlling the state-changing medium in such a process in response to the physical condition of the material in process. By this method, the supply of state-changing medium is automatically modified when the material in process has been congealed or thinned to a predetermined degree.

The principal feature of the invention resides in the provision of motor driven agitators moving in the material in process combined with means responsive to fluctuations in the electric current drawn by the motor to control the state-changing medium. Since the resistance to movement of the agitators depends upon the physical condition of the material and since the electric current drawn by the motor depends upon the resistance to movement of the agitators, such an arrangement provides a control for the state-changing medium which is entirely and automatically dependent upon the physical condition of the material under process.

Certain features of the invention disclosed but not claimed herein are claimed in copending applications Serial No. 316,567, filed November 1, 1928, Serial No. 262,339, filed March 17, 1928, Serial No. 329,596, filed December 31, 1928, and Serial No. 362,654, filed March 13, 1929.

The full nature of the invention will be understood from the accompanying drawing and the following description and claims.

In the accompanying drawing and specifications the invention is described as applied to a continuous ice cream freezer using ammonia as a refrigerant. However it is to be understood that the invention is not limited by such a description but is applicable as well to a wide range of other processes.

Fig. 1 is an elevational view of a continuous ice cream freezing apparatus with the electrical wiring for the refrigerant control shown diagrammatically. Fig. 2 is a cross sectional view of the processing chamber taken on the line 2—2 of Fig. 1.

A base 10 supports an electric motor 11, a gear housing 12 and a processing barrel 13. The processing barrel is of the multi-chamber type having a plurality of processing chambers 14 each containing an agitator shaft 15 carrying agitator blades 16. Each of the shafts 15 is driven by the motor 11 through suitable reduction gears carried in the gear housing 12. The material to be processed is supplied to the processing chambers through a material inlet pipe 17 by means of a pump not shown in the drawing. The material passes successively through each of the chambers 14 and is finally discharged in the finished condition from an outlet 18 into any suitable container.

Surrounding each of the chambers 14 is a refrigerant space 19 supplied with refrigerant from an intake pipe 20. In the apparatus disclosed herein ammonia is the preferred refrigerant and is supplied in a liquid condition under pressure from a condenser not shown to an inlet pipe 21. The inlet pipe communicates with an expansion valve 22 through which the ammonia is expanded and supplied in a partially vaporized condition through a pipe line 23 to an accumulator 24. The expansion valve 22 is controlled by a float 25 contained in the accumulator to maintain a supply of liquid refrigerant in the accumulator at a substantially constant level. From the accumulator the liquid ammonia is supplied to the processing apparatus by the pipe line 20 heretofore mentioned. A pipe line 26 communicates with the opposite end of each of the refrigerant spaces 19 and serves to remove evaporated refrigerant therefrom and to return said refrigerant to the accumulator 24. A pipe line 27 returns gaseous refrigerant from the accumulator to the compressor for recompression.

The motor 11 is herein assumed to be a three-phase alternating current motor and is supplied with electric current from main supply lines 28 by means of line contactors 29 and power lines 30, 31 and 32. A solenoid 33 serves, when energized, to close the line contactors 29 to supply current to the motor. In each of the lines 30 and 32 is placed an overload relay 34 adapted to open contactors in a line 35 when the motor current is above a predetermined value. Power to operate the solenoid 33 is supplied from one of the main power lines 28 through a line 36, a normally open start push button 37, a normally closed stop push button 38, the line 35 containing contactors controlled by overload relays 34 and connecting with the solenoid 33 and a return line 39 connected to another of the main supply lines 28. A line 40 connects one terminal of the

start push button 37 with one terminal of one of the main line contactors 29 as shown in the diagram. By this wiring the motor may be started by a momentary operation of push button 37 and thereafter will be operated by means of the circuit through line 40 until the stop push button 38 is operated or one of the overload relays 34 opens the circuit to solenoid 33.

Included in the line 31 is a relay 41 which operates to open a contactor in a line 42 when the current in line 31 reaches a predetermined value. The line 42 connects to the line 31 through the relay contactor just mentioned and connects at its opposite end to one terminal of a solenoid 43. A snap switch 46 is included in line 42. The opposite terminal of the solenoid 43 is connected by the line 44 to the power line 30. The solenoid 43 serves, when energized, to open a valve 45 in the pipe line 26. By this means the solenoid 43 is energized and the valve 45 is open so long as the motor is running and so long as the current drawn by the motor through line 31 is below the predetermined value for which the relay 41 is set. If the motor is shut down by the opening of contacts 29 the solenoid 43 is deenergized and valve 45 is closed. The closing of valve 45 and the continued evaporation of refrigerant in the refrigerant spaces 19 quickly forces all liquid refrigerant from the processing apparatus backward through pipe line 20 to the accumulator and thereby prevents a freezeup. Similarly, if the material in process becomes so stiff that the current required to operate the motor increases above the value for which the relay 41 is set the solenoid 43 is deenergized and a similar evacuation of refrigerant takes place. By varying the setting of the relay 41 the solenoid 43 may be made to operate when the material in process has reached any desired physical condition. By opening the snap switch 46, the liquid refrigerant may be similarly evacuated from the processing apparatus.

After the solenoid 43 has become deenergized and the flow of refrigerant is stopped, the continued supply of uncongealed material to the apparatus quickly reduces the resistance to agitation. The current drawn by the motor then decreases below the value for which the relay 41 is set and the said relay permits the closing of its contactor to energize the solenoid 43 and permit the reestablishment of refrigerant supply. The intermittent opening and closing of the valve 45 normally takes place with sufficient rapidity to provide a regulation of the action of the refrigerant which results in the production of a continuous stream of a substantially uniform product. In the production of ice cream by a batch process it has been proposed in the prior art to automatically stop the operation of the process when a predetermined physical condition of the material has been reached. The use of the term "regulating" in the appended claims is intended to distinguish from such a final stoppage of the process in which there is no control of the process after such stoppage.

When it is desired to regulate the flow of state-changing medium between predetermined limits instead of effecting a complete stoppage, a pipe 47 is used by-passing the valve 45. A valve 48 in this pipe line permits adjustments of the limit of control.

In the case of material to be thinned by means of a state-changing medium the contactor controlled by relay 41 is made normally open instead of normally closed. When the material in process has been thinned to the desired condition, the resistance to motion of the agitators is decreased, the current drawn by the motor decreases below the value for which relay 41 is set and the normally open contactor controlled thereby returns to open position, deenergizing its solenoid to close a valve and stop the supply of state-changing medium.

The invention claimed is:

1. An apparatus for processing material, including means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state changing medium, and mechanism for reducing and increasing the flow of said medium operable in response to the amount of electrical current required by said motor.

2. An apparatus for processing material, including means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state changing medium, and mechanism for reducing and increasing the flow of said state changing medium automatically operable to reduce said flow when the electric current required by said motor is greater than a predetermined value and to increase said flow when said current is less than said predetermined value.

3. An apparatus for processing material, including means for agitating said material, an electric motor for driving said agitating means, means for supplying a refrigerant, and mechanism for reducing and increasing the supply of said refrigerant operable in response to the amount of electric current required by said motor.

4. An apparatus for processing material, including means for agitating said material, an electric motor for driving said agitating means, means for supplying a refrigerant, and mechanism for reducing and increasing the supply of said refrigerant automatically operable to reduce said supply when the electric current required by said motor is greater than a predetermined value and to increase said supply when said current is less than said predetermined value.

5. An apparatus for processing material, including means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state changing medium, control means for said supply mechanism operable in response to the amount of electric current required by said motor to vary the rate of said supply between predetermined limits, and means for varying said limits at will.

6. An apparatus for processing material, including a container, means for passing a continuous stream of material therethrough, means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state changing medium, and mechanism for reducing and increasing the flow of said medium operable in response to the amount of electric current required by said motor.

7. An apparatus for processing material, including a container, means for passing a continuous stream of material therethrough, means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state changing medium, and mechanism for reducing and increasing the flow of said state changing medium automatically operable to reduce said flow when the electric current required by said motor is greater than a predetermined value and to increase said flow when said current is less than said predetermined value.

8. An apparatus for processing material including a processing container adapted to contain the material under process and having a surrounding jacket adapted to contain and normally retain a supply of liquid refrigerant, means for agitating said material, and mechanism operable in response to variations in the torque required to agitate said material for automatically evacuating said liquid refrigerant from said jacket.

9. An apparatus for processing material including a processing container adapted to contain the material under process and having a surrounding jacket adapted to contain and normally retain a supply of liquid refrigerant, means for agitating said material, and mechanism operable in response to variations in the torque required to agitate said material for automatically evacuating said liquid refrigerant from said jacket when the required torque exceeds a predetermined value.

10. An apparatus for processing material including a processing container having a surrounding jacket for normally retaining a supply of liquid refrigerant, an accumulator, a conduit for supplying said liquid refrigerant from said accumulator to said jacket, a second conduit returning refrigerant from said jacket to said accumulator, a valve in said last-mentioned conduit, an agitator for agitating the material under process, and control mechanism responsive to variations in the torque required to drive said agitator for closing said valve when said torque has increased above a predetermined value whereby liquid refrigerant in said jacket is expelled through said first-mentioned conduit to said accumulator by pressure generated by the evaporation of a part thereof.

11. Apparatus for processing material including a container having a surrounding jacket adapted to contain and normally retain a supply of liquid refrigerant for changing the physical condition of the material, and mechanism automatically operable in response to changes in the physical condition of the material to automatically evacuate said refrigerant from said jacket when a predetermined physical condition has been reached.

12. An apparatus for processing material including a container, means for passing a continuous stream of material therethrough, means for agitating said material, an electric motor for driving said agitating means, and mechanism for automatically regulating the degree of processing of said material in response to the amount of electric current required by said motor to produce a continuous stream of a uniform product.

13. An apparatus for processing material including a container, means for passing a continuous stream of material therethrough, means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state-changing medium, and means for automatically regulating said supply mechanism in response to the amount of electric current required by said motor to produce a continuous stream of a uniform product.

14. An apparatus for processing material including means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state-changing medium, and mechanism for stopping and starting the flow of said state-changing medium operable in response to the amount of electric current required by said motor.

15. An apparatus for processing material including means for agitating said material, an electric motor for driving said agitating means, mechanism for supplying a state-changing medium, and mechanism for stopping and starting the flow of said state-changing medium operable to stop said flow when the electric current required by said motor is greater than a predetermined value and to reestablish said flow when said current is less than said predetermined value.

16. An apparatus for processing material including a container, means for passing a continuous supply of material therethrough, means for agitating said material, an electric motor for driving said agitating means, means for refrigerating said material, and means for automatically regulating said refrigerating means in response to the amount of electric current required by said motor to produce a continuous stream of a uniform product.

17. An apparatus for processing material including means for agitating said material, an electric motor for driving said agitating means, means for supplying a refrigerant, and mechanism for stopping and starting the supply of said refrigerant operable in response to the amount of electric current required by said motor.

18. An apparatus for processing material including means for agitating said material, an electric motor for driving said agitating means, means for supplying a refrigerant, and mechanism for stopping and starting the supply of said refrigerant operable to stop said supply when the electric current required by said motor is greater than a predetermined value, and to reestablish said supply when said current is less than said predetermined value.

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